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NASA TECH BRIEF

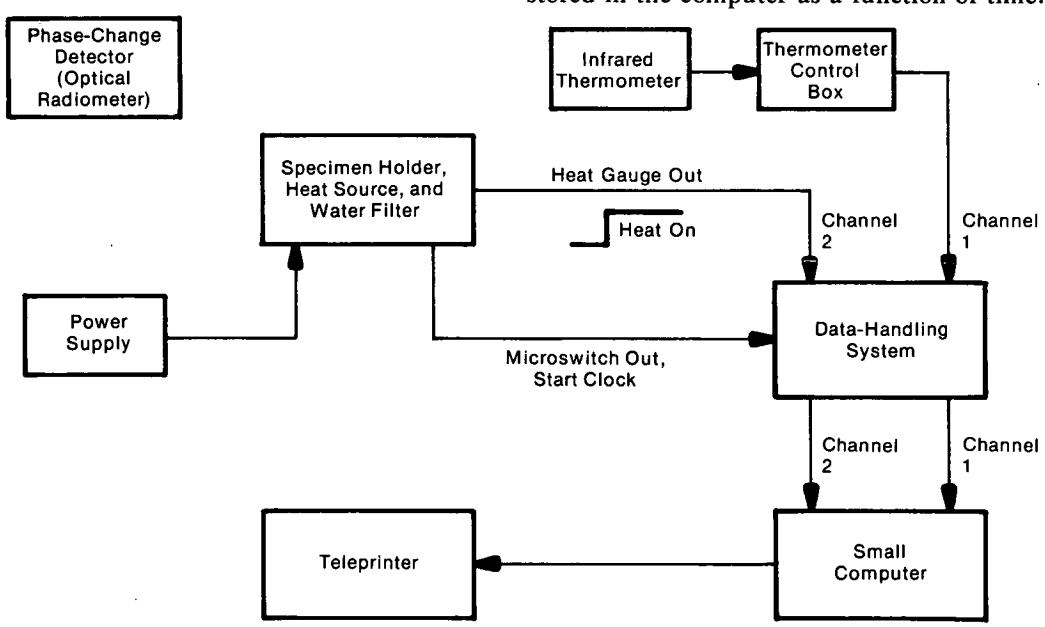
Langley Research Center

Automated Electronic System for Measuring Thermophysical Properties

An automated data-reduction procedure for use in measuring thermophysical parameters has been developed. This measurement system is an extension of the technique, presented in Langley Research Center Tech Brief 73-10447 (LAR-11053), in which phase-change coatings (Tempilaq) are used to measure surface temperature accurately under transient heating conditions.

The phase-change coating technique consists of using a test specimen or model made from a low-thermal-conductivity material covered with Tempilaq (wax crystals which melt at a prescribed temperature). When the model is heated, the coating melts when the surface reaches the calibrated phase-change temperature. This melt temperature, the time to reach melt temperature from the initial temperature, and the heating rate can be used to determine the thermophysical properties. This automated system can be used with models which are either coated or uncoated. Temperature is continuously monitored by an infrared thermometer, and the corresponding elapsed time is accurately recorded by an electronic data-handling system.

A sample of the material is placed in front of a radiant heat source in the specimen holder (see block diagram). With the heat source off, the infrared radiometer is sighted onto the region of the specimen to be measured. If the specimen is in thermal equilibrium with the ambient, its temperature is measured, using a surface-contacting thermometer, and is entered into the computer. The heat lamps are turned on, and the shutter is opened. A microswitch on the shutter starts the analog data converter, and both heat gauge and specimen temperatures are stored in the computer as a function of time.



System Diagram for Measuring Thermophysical Properties

(continued overleaf)

When all of the data is stored, the thermophysical parameter $\sqrt{\rho ck}$ (where ρ is the density, c is the specific heat, and k is the thermal conductivity) is computed as a function of the specimen temperature. An optical radiometer is used to detect the change in reflected light when the coating changes phase.

The advantages of this system are that: (a) it performs the measurements over 30 temperature increments in only a few minutes, and (b) there is no uncertainty in the elapsed-time measurement due to slow melting of the phase-change coating. The results of measurements taken on Stycast specimens show that the system can provide accurate and fast measurements of the $\sqrt{\rho ck}$.

Notes:

1. The following documentation may be obtained at cost from:

   North Carolina Science and Technology
   Research Center
   P. O. Box 12235
   Research Triangle Park, North Carolina 27709

   Reference: NASA CR-2511, An Electronic System for Measuring Thermophysical Properties of Wind Tunnel Models

2. Technical questions may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Mail Stop 139-A
   Hampton, Virginia 23665
   Reference: B75-10160

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
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